

## Notes 1/5 - All About i

i - imaginary number

Definition  $i = \sqrt{-1}$  or  $i^2 = -1$

→ Now we can take  $\sqrt{\quad}$   $\sqrt[4]{\quad}$  even root of a negative number, but the answer is imaginary

Complex number  $a + bi$

Ex:  $6 + 3i$   
          ↑          ↑  
      real      imaginary

## Square roots of negative numbers

→ need  $i$  to  $\sqrt{\quad}$  a negative!

$$\text{Ex 1: } \sqrt{-9} = \sqrt{9} \sqrt{-1} = 3i$$

↑  
since  $-9 = 9 \cdot (-1)$

↑ simplified  
each  $\sqrt{\quad}$

$$\text{Ex 2: } \sqrt{-25} = \sqrt{25} \sqrt{-1} = \boxed{5i}$$

$$\text{Ex 3: } \sqrt{-4x^2} = \sqrt{4} \sqrt{-1} \sqrt{x^2} = 2xi$$

Do:

1)  $\sqrt{-49}$

2)  $\sqrt{-144}$

3)  $\sqrt{121}$

4)  $\sqrt{-36y^2}$

# Adding and Subtracting Complex Numbers

a Complex number :  $a + bi$

↑                      ↑  
real component      imaginary  
(no  $i$ )                  component ( $i$ )

Ex:  $3+2i$ ,  $8-7i$

■ To add or subtract complex numbers, just treat  $i$  like a variable and combine like terms!

$$\text{Ex 1: } (3+2i) + (5+6i) = \boxed{8+8i}$$

↑                      ↑  
 $3+5$                    $2i+6i$

$$\text{Ex 2: } (5+3i) - (2-4i)$$
$$= 5+3i - 2+4i = \boxed{3+7i}$$

Do: 1)  $(5+6i) + (9+3i)$

2)  $(7+4i) + (3-5i)$

3)  $(6-2i) - (4+9i)$

4)  $(-2+3i) - (6-8i)$

## Multiplying Imaginary Numbers

- Do the first steps like normal
- When you get  $i^2$ , simplify  $i^2 = -1$

Ex 1:  $(6i)(2i) = 12i^2 = 12(-1) = -12$   
since  $i^2 = -1$

Ex 2:  $(-4i)(3i) = -12i^2 = -12(-1) = 12$

Ex 3:  $f(x) = 2x^2 + 1$ , find  $f(3i)$

$$f(3i) = 2(3i)^2 + 1$$

$$= 2(9i^2) + 1$$

$$= 18i^2 + 1$$

$$= 18(-1) + 1 = -18 + 1 = \boxed{-17}$$

Do:

1)  $(-4i)(5i)$

2)  $(10i)(3i)$

3)  $f(x) = 3x^2 - 4$ , find  $f(2i)$

## Multiplying Complex #5

- Do all of the first steps like normal!
- At the end, make  $i^2 = -1$  and keep simplifying

Ex 1:  $(2 + 4i)(3 - i)$

$$= 6 - 2i + 12i - 4i^2$$

$$= 6 + 10i - 4i^2$$

$$= 6 + 10i - 4(-1) \quad \leftarrow \text{since } i^2 = -1$$

$$= 6 + 10i + 4$$

$$= \boxed{10 + 10i}$$

Ex 2:  $(-4 + 5i)(-4 - 5i)$

$$= 16 + 20i - 20i - 25i^2$$

$$= 16 - 25i^2$$

$$= 16 - 25(-1)$$

$$= 16 + 25$$

$$= \boxed{41}$$

Do:  $(6 + 4i)(9 - 3i)$

2)  $(2 - 6i)(2 + 6i)$